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NATIONAL BUREAU OF STANDARDS • A. V. Astin, *Director*

Sound Insulation of Wall, Floor, and Door Constructions

Richard V. Waterhouse

Supplement to Building Materials and Structures Report 144

Issued February 27, 1956

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The sound insulation figures are presented for 13 building structures that were measured at the National Bureau of Standards in the period March 1954 to June 1955. The details are also given of a change in the method of measuring impact sound insulation.

1. Introduction

Building Materials and Structures Report 144,[1] issued February 25, 1955, included the results of sound insulation measurements made at the National Bureau of Standards before March 1954. This supplement includes the results of sound insulation measurements made on 13 building constructions in the period March 1954 to June 1955. It also includes details of a change in the method of measuring impact sound insulation.

The test panels measured 5½ by 7 ft except for the door, which was 2½ by 7 ft. The measurements were made in accordance with the "Tentative Recommended Practice for Laboratory Measurement of Airborne Sound Transmission Loss of Building Floors and Walls," Number E 90-50T, of the American Society for Testing Materials. Further details of the measuring technique are given on p. 8 of the publication BMS144 referred to above. Most of the measurements cited here were performed by Howard S. Bowman and Henry J. Leinbach Jr., of the Sound Section.

Differences of one or two db in the average transmission loss of panels are not generally of practical significance, as the human ear can hardly detect such changes. Average transmission loss results are generally repeatable within ± 1 db for any particular panel and within ± 2 db for nominally identical constructions. Estimates of the absolute accuracy of sound transmission loss data are difficult to make; experimental conditions necessarily depart somewhat from the ideal conditions assumed in the theory, and it is not easy to judge how much such departures affect the results. However, we estimate that even in extreme cases the measured average transmission loss figure would be within ± 5 db of the true figure.

[1] For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 40 cents.

2. Impact Noise Measurement

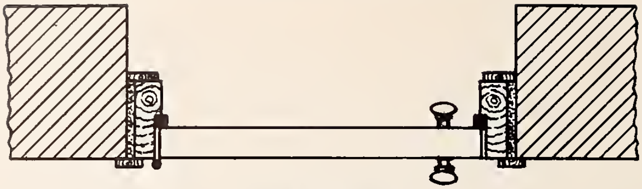
The *impact noise levels* given in the results for the floor panels 711 and 712 give a measure of the relative insulation of the panels to impact noises (as opposed to airborne noises), and are obtained as follows:

When a standard tapping machine is operating on the test panel, the sound pressure level is measured in the room below the panel in octave bands over the frequency range 125 to 4,000 cps. The sound level in each octave band is corrected to a standard room absorption of 10 square meters, the room absorption at the various frequencies being known. From these corrected levels the total corrected sound pressure is computed, and this is called the *impact noise level*. The correction procedure follows a proposed international standard, see Acoustics Group Symposium, p. 36, The Physical Society, London (1949).

The tapping machine used in the measurements has five metal hammers, each weighing 0.84 lb, which fall a distance of 2.7 in. onto the test panel. The hitting surface of each hammer is flat and circular, with a diameter of 1 inch. The hammers are spaced about 3 in. on centers, and the machine gives one tap every ⅒th second.

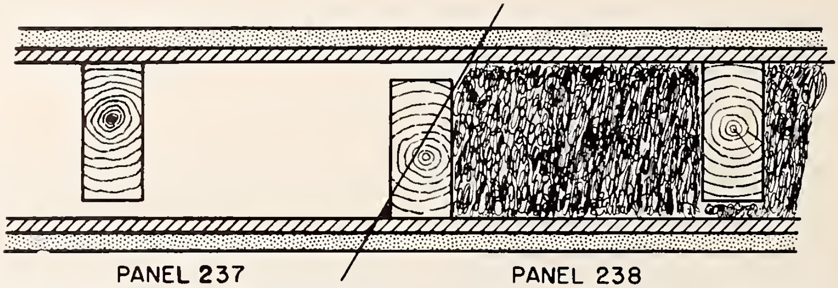
The *impact noise level* used here supersedes the *tapping loss* used previously as a measure of impact noise insulation, for example in BMS Report 144. The *impact noise level* is considered more architecturally significant than the *tapping loss* since the latter depends on a quantity which is largely irrelevant, namely the sound-pressure level in the room containing the tapping machine. It is the sound level to be expected in the room below the impact which is important when a floor-ceiling structure is being chosen.

The differences in the methods of measuring the *impact noise level* and the *tapping loss* are such that the conversion of numerical values from one to the other is not feasible.



PANEL 616

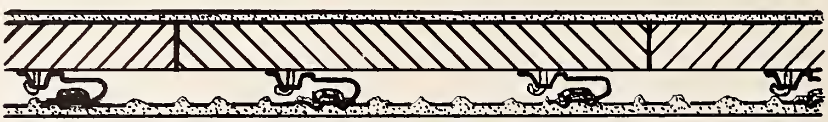
PANEL 616. *3- by 30- by 84-in. wooden door, of special soundproof construction; sponge-rubber gasket around sides and top, approximately ½-in. square cross-section, chamfered on hinge side; and a sponge-rubber drop closure at bottom of door.*



PANEL 237 PANEL 238

PANEL 237. *Staggered 2- by 4-in. wood studs, each set 16 in. on centers and spaced 8 in. on centers with ½ in. offset from the other set. On each side ⅜-in. plain gypsum lath and ½ in. of gypsum vermiculite plaster.*

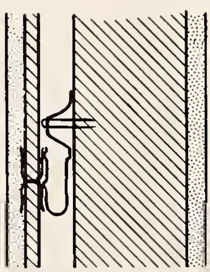
PANEL 238. *Same as panel 237 except airspace filled with vermiculite fill. Density of fill was 6.3 lb/ft^3 or 1.8 lb/ft^2 of panel area.*



PANEL 313/317

PANEL 313. *3- by 12- by 30-in. hollow gypsum blocks. On one side ½-in. sanded gypsum plaster; on other side resilient clips, spaced 18 in. on centers vertically and 16 in. on centers horizontally, held vertical ¾-in. metal channel 16 in. on centers, expanded metal laih and ⅞ in. of sanded gypsum plaster.*

PANEL 317. *Same as panel 313 except 4- by 12- by 30-in. gypsum blocks were used.*



PANEL 314/318

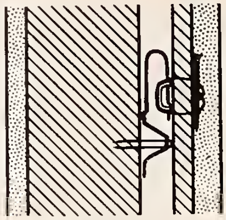
PANEL 314. *3- by 12- by 30-in. hollow gypsum blocks. On one side ½-in. sanded gypsum plaster; on other side resilient clips, stapled 16 in. on centers horizontally and vertically, held ⅜-in. gypsum lath and ½ in. of sanded gypsum plaster.*

PANEL 318. *Same as panel 314 except 4- by 12- by 30-in. gypsum blocks were used.*

TABLE 1. *Sound Transmission Loss and Impact Noise Levels of Some Building Structures*

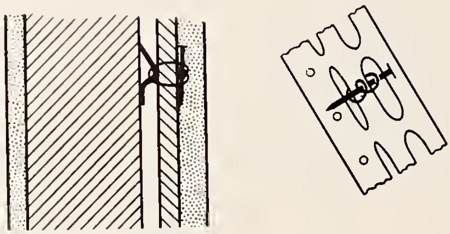
Panel number	Transmission loss in decibels for various frequencies (cycles per second)										Weight lb/ft [2]	Impact noise level,[a] db
	125	175	250	350	500	700	1,000	2,000	4,000	Average 125 to 4,000		
						DOOR						
616	31	27	32	30	33	31	29	37	41	**32**	7	--------
						WALLS						
						Wooden Studs						
237	36	37	33	39	42	40	42	41	51	**40**	11. 1	--------
238	37	37	37	42	49	49	50	52	66	**47**	12. 9	--------
						Hollow Gypsum Tile						
313	38	40	37	40	44	48	51	56	59	**46**	27	--------
317	45	44	44	47	50	53	55	56	59	**50**	31	--------
314	42	41	43	46	48	51	53	56	60	**49**	24	--------
318	43	41	42	46	52	52	56	55	61	**50**	26	--------

[a] See definition in text.



PANEL 315

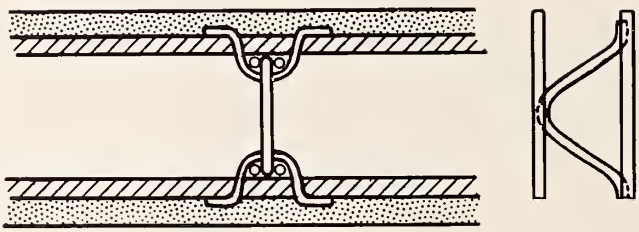
Panel 315. *3- by 12- by 30-in. hollow gypsum blocks. On one side ½ in. of sanded gypsum plaster; on other side resilient clips (same as clips of panels 313, and 317 above) stapled 24 in. on centers horizontally, 28 in. on centers vertically, held ¾-in. horizontal metal channels and ½-in. long-length gypsum lath wire-tied to the channels, and ¾ in. of sanded gypsum plaster.*



PANEL 316/319

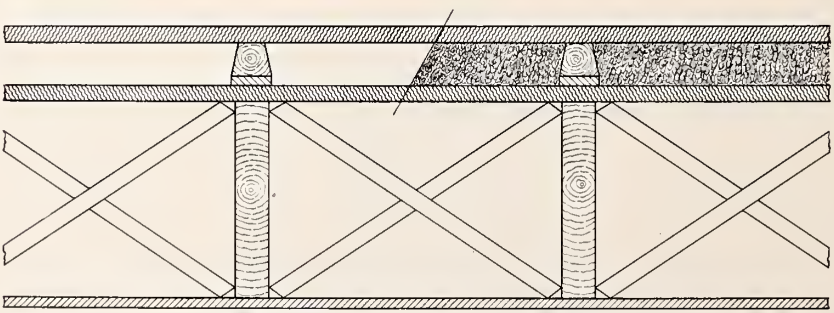
Panel 316. *3- by 12- by 30-in. hollow gypsum blocks. On one side ½ in. of sanded gypsum plaster; on other side slotted resilient metal runners, placed horizontally 25 in. on centers, ½-in. long-length gypsum lath wire-tied to the runners, ¾ in. of sanded gypsum plaster.*

Panel 319. *Same as panel 316 except 4- by 12- by 30-in. gypsum blocks were used.*



PANEL 438

Panel 438. *2½- by ½-in. steel trusses used as studs 16 in. on centers. On each side resilient clips held ⅜-in. gypsum lath and ½ in. of gypsum vermiculite plaster; edges of lath held by other clips.*



PANEL 711 PANEL 712

Panel 711. *2- by 10-in. wood joists 16 in. on centers, cross braces with 1- by 3-in. wooden bridging strips bisecting length of panel. On ceiling side ½-in. gypsum wall-board, joints filled and taped; on floor side ¾-in. subflooring, rosin paper, and floating floor consisting of ½- by 2-in. fiberboard 16 in. on centers, trapezoidal sleepers (1⅛ in. wide at top, 2 in. at bottom, 1⅝ in. thick) 16 in. on centers, 25/32-in. oak flooring.*

Panel 712. *Same as panel 711 except airspace in floating floor filled with vermiculite fill. Density of fill was 7.8 lb/ft^3 or 1.2 lb/ft^2 of panel area.*

Panel number	Transmission loss in decibels for various frequencies (cycles per second)										Weight lb/ft ²	Impact noise level,[a] db
	125	175	250	350	500	700	1,000	2,000	4,000	Average 125 to 4,000		
						WALLS—Continued Hollow Gypsum Tile—Continued						
315	48	43	41	43	47	48	44	55	62	**48**	27	--------
316	41	40	40	43	46	44	46	58	61	**47**	26	--------
319	41	41	40	43	49	49	49	57	62	**48**	26	--------
						Steel Studs						
438	27	26	28	32	39	41	44	38	49	**36**	9	--------
						FLOORS						
711	30	20	29	30	37	40	42	50	56	**37**	11. 4	88
712	24	21	30	33	40	41	46	52	58	**38**	12. 6	84

[a] See definition in text.

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Sound Insulation of Wall, Floor, and Door Constructions

Richard V. Waterhouse, Raymond D. Berendt, and
Richard K. Cook

2d Supplement to Building Materials and Structures Report 144

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Sound Insulation of Wall, Floor, and Door Constructions

Richard V. Waterhouse, Raymond D. Berendt, and Richard K. Cook

Sound insulation data are presented for building structures measured at the National Bureau of Standards in the period July 1955 to December 1956. These figures constitute the second supplement to the data published in Building Materials and Structures Report 144. The accuracy of the figures is discussed. Details are also given of a new average figure, called the *Energy Average*, for the over-all sound insulation of a panel, and why it is preferable to the *Decibel Average*, which it is designed to supersede.

1. Introduction

Building Materials and Structures Report 144,[1] issued in February 1955, and its first supplement, issued in February 1956, included the results of sound insulation measurements made at the National Bureau of Standards through June 1955. This second supplement gives results for 28 building constructions obtained in the period July 1955 through December 1957.

The test panels measured approximately 5½ by 7 ft except for most of the doors, whose dimensions are given with the panel descriptions. The measurements were made in accordance with the American Standard Recommended Practice for Laboratory Measurement of Air-Borne Sound Transmission Loss of Building Floors and Walls, Number Z24.19–1957, except for the fact that the average sound transmission loss values given here are based on the 11 frequencies cited, and not only on the 9 given in Z24.19. Further details of the measuring technique are given on page 8 of BMS144 referred to above. The measurements cited here were made with the assistance of H. J. Leinbach, Jr., and J. W. Harris of the Sound Section.

A new feature of the results presented here is that sound transmission loss (STL) figures at the frequencies 1,500 and 3,000 cps are included for most of these panels and the corresponding averages include the values at these frequencies. The advantage of including STL values at these two frequencies is that the frequency range 125 to 4,000 cps is then covered throughout at approximately equal intervals of ½ octave. Thus a curve of STL versus frequency for a given panel can be drawn more accurately. Also, the averages derived from the values at the different frequencies are not unduly weighted towards the low end of the frequency range, as was the case before the two new frequencies were added.

2. New Average Figure for the Sound Insulation of a Panel

Another new feature of the results presented here is the use of a new average, called an *Energy Average*, for the over-all sound insulation of a panel. Most people agree that it is better to use several figures to cover the entire range of frequencies, but that a single figure for the sound insulation is a practical necessity for the architect and builder.

The problem of finding a representative single figure for the sound insulation of a panel, based on the values at the different frequencies, is complicated by the fact that the insulation the panel affords in practice depends on the spectrum of the noise present; also the sensitivity of the ear varies with the frequency of the sound.

For this single figure the arithmetic average of the decibel STL values at the different frequencies has often been used in the past, but it is generally agreed to be far from perfect.

The chief objection to the decibel average is that it does not rank panels correctly as regards their useful over-all sound insulation. This is a serious objection. It can happen, and has happened, that a construction with a high decibel average has been used on a building job when a less expensive construction, with a lower decibel average, would have given as good over-all sound insulation.

For this reason, the decibel average has been superseded by a more accurate index in most countries that are concerned with the measurement of sound insulation.[2]

The reason the decibel average is defective is that when the decibel figures are averaged, the

[1] For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 40 cents

[2] See Handbook of Noise Control, edited by C. M. Harris, published by the McGraw-Hill Book Co., ch. 40.

higher STL values get too strong a weighting. This can be seen from the fact that the decibel average of the STL figures for a hypothetical panel can become arbitrarily large if only one of the STL figures is increased. This is a quite unrealistic state of affairs, since increasing one STL value corresponds to reducing the energy that would be transmitted by a panel at that frequency, and as this energy is reduced it should influence the average less, and not become the controlling factor.

The new method used here is to average the energy ratios to which the decibel figures correspond, instead of the decibel figures themselves. The average of the ratios is then converted back into the decibel form. The averaging of ratios in this way removes the arbitrary logarithmic weighting of the decibel average.

The result is called an *Energy Average*, as opposed to a decibel average. It can also be called an *average noise reduction* since it is equal to the decibel reduction in level suffered by randomly incident white-noise of equal energy per octave in passing through the panel. The noise considered here is of equal energy per octave because the frequency bands used in the STL measurements under discussion are evenly spaced on an octave scale, e. g., at ½ or ⅓ octave intervals, and each band is given equal weight in the average. Thus the *Energy Average* has a clear and definite physical interpretation.

It is recommended that when a single figure is used for comparing the over-all sound insulation of two panels, the *Energy Average* should be used rather than the decibel average. In some cases this will reverse the rank ordering of two panels. For example, in table 3, page 9, panel 239 has a higher *decibel average*, but a lower *Energy Average* than panel 243; here panel 243 would give better over-all sound insulation.

In table 2, page 3 of this Supplement, are given the *Energy Averages* for the panels listed in BMS144, excepting panels tested before 1932; for the latter, the available data were insufficient for useful average values to be obtained. When STL values at 1,500 and 3,000 cps only were lacking, these were interpolated.

Table 1 shows how the *Energy Average* is obtained, and compares it to the decibel average for a panel whose STL figures increase 5 db per octave. This behavior is typical of many panels.

A further discussion of the *Energy Average* is given in the Journal of the Acoustical Society of America, vol. 29, p. 544 (1957); in the latter paper the *Energy Average* is referred to as the *Linear Average*.

Table 1. *Sample calculation of the Energy Average*

Frequency	STL	Energy ratio
cps	*db*	
125	20. 0	1. 000 $\times 10^{-2}$
175	22. 5	0. 562
250	25. 0	. 316
350	27. 5	. 178
500	30. 0	. 100
700	32. 5	. 056
1,000	35. 0	. 032
1,500	37. 5	. 018
2,000	40. 0	. 010
3,000	42. 5	. 006
4,000	45. 0	. 003
Total	357. 5	2. 281 $\times 10^{-2}$
Decibel average	**32. 5 db**	
Energy Average		**26. 8 db**

3. Accuracy of Results

Differences of 1 or 2 db in the Energy Averages of panels are not generally of practical significance, as the human ear can hardly detect such changes. Our measurements of the Energy Average are generally repeatable within ±1 db for any particular panel and within ±2 db for nominally identical constructions.

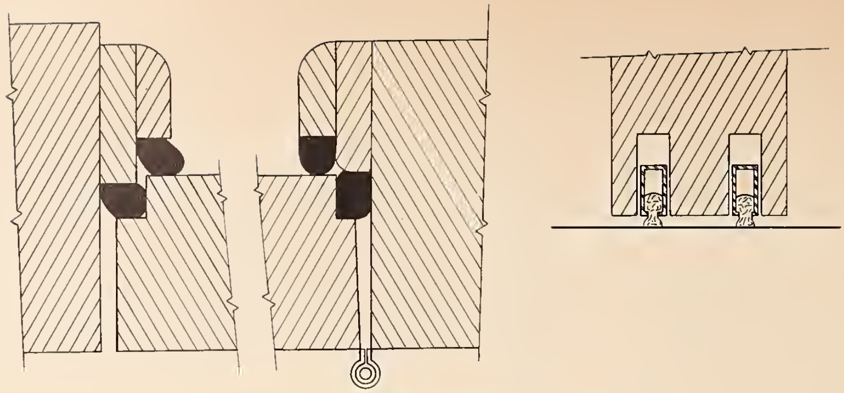
Estimates of the absolute accuracy of sound transmission loss data are difficult to make; experimental conditions necessarily depart somewhat from the ideal conditions assumed in the theory, and it is not easy to judge how much these departures affect the results. The chief sources of error are (1) the imperfect diffusion of the sound fields used in the test measurement, (2) the arbitrary nature of the edge condition of the test panel, and (3) the limited size of the test panel. However, we estimate that in most cases the measured Energy Average STL figure would be within ±5 db of the true figure for a large panel, i. e., a panel large enough for its lowest vibrational mode to be well below the lowest measuring frequency.

With regard to the accuracy of the measured STL values at the various frequencies, the values at 125, 175, and 250 cps are less accurate than those at the other frequencies, since the rooms on either side of the test panel are too small in volume to give a sufficiently diffuse sound field at low frequencies.

The above comments on repeatability and accuracy refer only to results obtained at the National Bureau of Standards. These results may differ by several decibels from those obtained on nominally identical panels at other laboratories.

Table 2. *Energy Averages for some of the panels listed in BMS144*

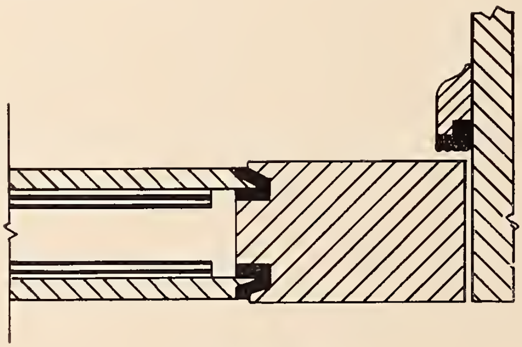
Panel number	Energy average	Decibel average	Panel number	Energy average	Decibel average	Panel number	Energy average	Decibel average	Panel number	Energy average	Decibel average
	db	*db*		*db*	*db*		*db*	*db*		*db*	*db*
136A	43	53	179A	24	31	306	38	39	503	35	38
136B	51	61	179B	24	35	307	50	53	504	34	37
137	41	53	179C	25	35	308	48	49	505	35	38
137A	46	54	179D	23	34	309	38	40	506	36	39
137B	37	55	180A	30	38	310	41	46	507	36	40
144	41	46	180B	40	50	311	19	20	508	39	42
145	40	45	180C	42	50	312	41	44	509	43	47
146	32	35	180D	43	50	313	42	46	510	31	36
147A	38	42	180E	38	46	314	46	49	511	37	40
147B	41	47	180F	38	49	315	46	48	512	38	40
148	35	41	181	28	28	316	44	47	513	40	42
149	41	48	182	28	30	317	48	50	514	41	42
150	49	52	201	32	38	318	47	50	515	40	41
151	39	50	202	30	35	319	45	48	516	34	37
152	44	51	203	27	33	401	29	41	517	33	35
153	40	47	204	30	37	402	37	42	518	35	39
154	38	40	205	34	41	403	31	39	519	31	34
155	38	41	206	21	32	404	31	38	520	40	41
156	47	54	207	25	33	405	33	39	521	35	37
157	48	55	208	26	28	406	36	40	522	35	37
158	47	55	209	35	40	407	36	41	523	37	39
159	32	33	210	19	30	408	37	42	524	36	38
160A	53	55	211	21	24	409	37	42	525	32	33
160B	52	55	212	35	40	410	37	43	526	28	33
160C	51	54	213	48	51	411	37	43	527	36	38
160D	49	53	214	21	26	412	42	47	528	29	30
160E	49	53	215	44	46	413	35	42	601	26	30
160F	48	51	216	27	35	414	44	46	602	31	33
160G	48	51	217	30	37	415	36	42	603	34	36
160H	47	48	218	31	39	416	42	44	604	35	36
160I	44	46	219	34	43	417	38	44	605	28	30
161	36	38	220	49	52	418	45	47	606	23	24
162	34	42	221	40	46	419	40	45	607	33	38
163	28	36	222	51	54	420	50	52	612	34	35
164	35	44	223	49	52	421	49	52	613	38	40
165	34	39	224	28	35	422	49	52	616	31	32
166A	33	37	225	32	38	423	45	51	701	32	45
166B	36	38	226	34	40	424	42	46	702	37	50
167	49	52	227	34	40	425	51	52	703	35	45
168	53	55	228	34	39	426	45	47	704	34	47
170	33	36	229	37	40	427	48	51	705	51	56
171A	35	38	232	33	34	428	38	41	706	52	54
171B	32	35	233	39	40	429	54	55	707	31	40
171C	31	36	234	29	34	430	42	47	708	32	42
172	34	39	235	42	43	431	40	44	709	46	49
173A	36	37	236	43	45	433	41	44	710	48	51
173B	32	35	237	39	40	434	39	42	711	29	37
173C	10	11	238	42	47	435	34	39	712	29	38
174	31	35	301	38	42	436	39	43	801	41	43
175	49	50	302	36	41	437	34	39	802	46	49
176	46	48	303	36	38	438	32	36	803	44	48
177	28	36	304	38	39	501	32	34	804	40	47
178	42	46	305	42	43	502	32	38	805	44	51



PANEL 617. Bottom closure of door.

Panel 617. *2½-in. by 3-ft by 7-ft solid wooden door, 2 drop felts built into bottom; two tubular soft rubber gaskets mounted on door jamb gave a double seal at top and sides.*

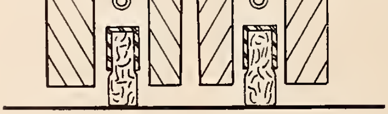
Panel 618. *Seals similar to those of panel 617; 2½-in. by 3-ft by 7-ft sound-insulating wooden door consisting of a 25⅝- by 70⅝-in. panel set centrally in both 3- by 7-ft faces; panels separated from outer frame by ¼-in. rubber, as shown in drawing for panel 624.*



PANEL 624.

Panel 624. *3-in. by 7-ft by 3-ft sound-insulating door of construction similar to that in panel 618; screwed onto the jamb at top and both sides were wooden strips to which were glued and lap-jointed a soft rubber gasket with a corrugated front edge. Sponge-rubber drop closure at bottom.*

Panel 639. *2⅝-in. by 3-ft by 7-ft sound-insulating wooden door of double construction: 2 interlocking frames separated by felt sheet; door hung in split frame with felt insert; seals similar to those of panel 617 except 2 drop-felts were replaced by a double tubular rubber gasket which closed onto a tapered wooden threshold.*



PANEL 640. Bottom closure of door.

Panel 640. *Door same as in panel 639; seals same as in panel 617.*

Panel 641. *4-in. by 3-ft by 7-ft sound-insulating wooden door; construction and seals similar to those of panel 640.*

Panel 642. *Same as panel 641 except the door was rigidly plastered into the jamb on both sides.*

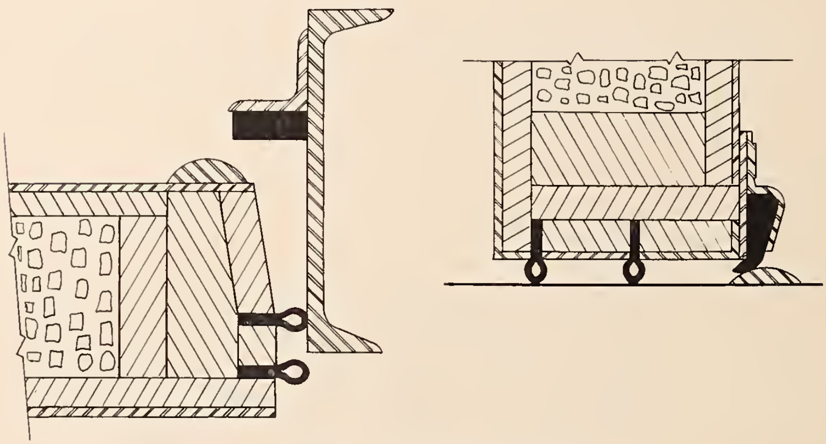
Table 3. *Sound Transmission Loss of Some Building Structures*

Panel number	Transmission loss (in decibels) at frequencies (cycles per second)													Weight lb/ft^2
	125	175	250	350	500	700	1,000	1,500	2,000	3,000	4,000	Decibel average 125 to 4,000	Energy average 125 to 4,000 [a]	
DOORS														
617	28	31	27	22	28	27	28	------	34	------	32	29	[b] 28	5.6
618	27	32	33	31	36	35	32	------	39	------	34	33	[b] 32	6.8
624	28	32	34	34	38	38	37	------	42	------	43	36	[b] 35	7.3
639	31	30	35	29	36	34	36	39	44	47	48	37	34	7.3
640	34	30	35	30	32	32	33	36	42	42	38	35	33	6.6
641	34	32	37	36	39	43	42	45	51	53	53	42	38	12.3
642	39	37	41	40	45	47	50	54	56	58	62	48	43	12.3

[a] See definition and discussion of this term in the text.
[b] Energy Average of sound transmission loss (STL) figures at 11 frequencies; STL figures at 1,500 and 3,000 cps were interpolated.

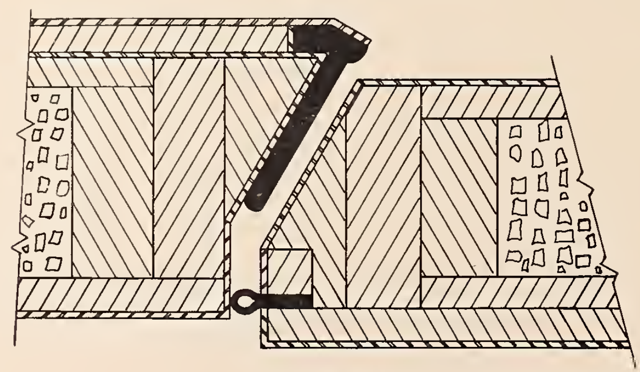
PANEL 645.

PANEL 645. *4½-in. by 2-ft 6-in. by 6-ft 6-in. sound-insulating door, coverd with unperforated sheet metal on both sides, mounted in metal frame; door and frame both flanged, with ½-in. thick sponge-rubber gaskets at top and sides; seal at the bottom of the door provided by a ⅜-in. rubber strip and door flange closing onto a metal threshold.*



PANEL 643. Bottom closure of door.

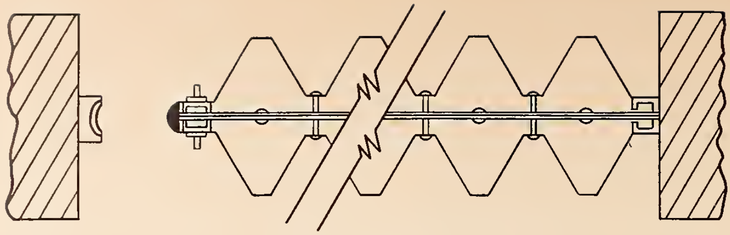
PANEL 643. *5¾-in. by 4-ft 8-in. by 6-ft 2-in. metal-clad door, which closed at top and sides against a 2- by 2-in. steel angle lined with ⅝-in. thick sponge-rubber; in addition a double rubber gasket provided a seal around all four edges of the door. The bottom edge of the door also carried a rubber strip which closed against a half oval metal threshold. The 4-in. internal airspace of door was filled with pieces of cork.*



PANEL 644.

PANEL 644. *Metal-clad double door, 5¾-in. by 6-ft 2-in. by 4-ft 8-in. over-all; top, side, and bottom seals similar to those of panel 643 except at the bottom a sponge-rubber drop-closure replaced the two tubular gaskets. Where the 2 doors met, the vertical crack was covered by a flange projecting from 1 door; the flange and door-edge were lined with ⅝-in. sponge-rubber; an extra seal where the doors met was given by a tubular rubber gasket. Cork fill as in panel 643.*

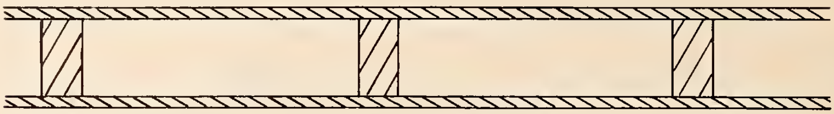
Panel number	Transmission loss (in decibels) at frequencies (cycles per second)													Weight lb/ft [2]
	125	175	250	350	500	700	1,000	1,500	2,000	3,000	4,000	Decibel average 125 to 4,000	Energy average 125 to 4,000 [a]	
DOORS—Continued														
645	33	30	31	28	31	31	33	38	38	42	42	34	32	13.0
Refrigerator-Type Doors														
643	41	35	40	43	49	50	52	54	57	60	64	50	43	24
644	36	32	41	44	48	52	53	54	56	58	61	49	40	31



PANEL 646A.

PANEL 646. *6-ft 4-in. by 4-ft 10-in. accordion type folding door consisting of 20 vertical panels forming 10 pleots on each side, held on a folding metol frame; inside this outer case were 2 composition-boord liners ⅛-in. thick; rubber sweep-strips covered the top and bottom edges of the door on both sides. The vertical edge was lined with a ½-in. round rubber bumper and closed onto 2 sponge-rubber strips.*

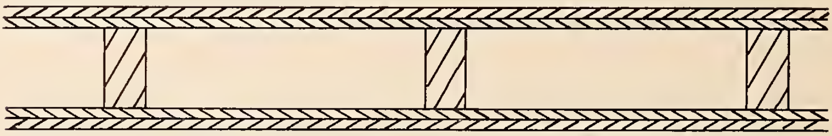
PANEL 646A. *Same as ponel 646 except the two inner liners were removed, and the sweep strips at top and bottom on one side only.*



PANEL 240.

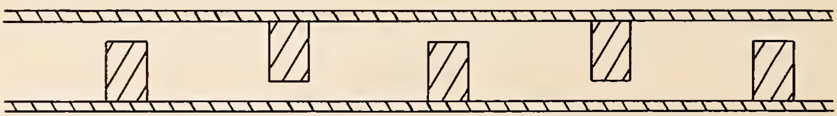
PANEL 239. *2- by 4-in. wood studs 16 in. on centers; ⅜-in. gypsum lath, ½-in. sanded gypsum plaster.*

PANEL 240. *2- by 4-in. wood studs 16 in. on centers; ⅝-in. tapered-edge gypsum wallboard; joints cemented and toped.*



PANEL 241.

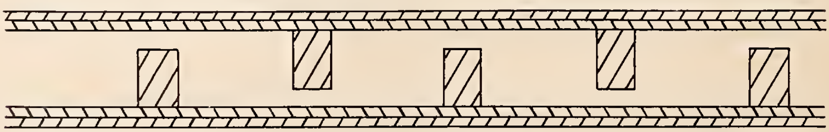
PANEL 241. *2- by 4-in. wood studs 16 in. on centers; 2 layers of ⅝-in. tapered-edge gypsum wallboard; joints cemented and taped.*



PANEL 242.

PANEL 242. *2- by 3-in. wood studs 16 in. on centers, staggered; ½-in. tapered-edge gypsum wallboard; joints cemented and taped.*

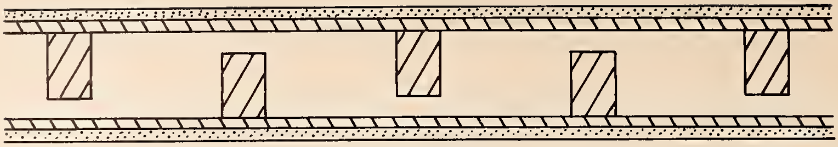
PANEL 243. *2- by 3-in. wood studs 16 in. on centers, staggered; ⅝-in. tapered-edge gypsum wallboord; joints cemented ond taped.*



PANEL 244.

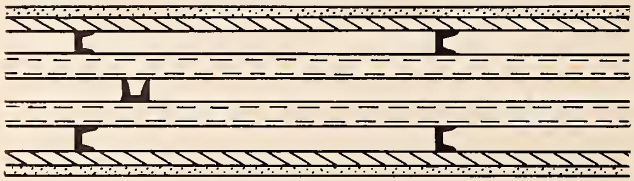
PANEL 244. *2- by 3-in. wood studs 16 in. on centers, staggered; 2 layers of ⅝-in. tapered-edge gypsum wollboord noiled on; joints cemented and taped.*

Panel number	Transmission loss (in decibels) at frequencies (cycles per second): 125	175	250	350	500	700	1,000	1,500	2,000	3,000	4,000	Decibel average 125 to 4,000	Energy average 125 to 4,000 [a]	Weight lb/ft ^{2}
DOORS—Continued														
Folding Doors														
646	20	18	18	19	24	29	31	31	32	32	35	26	22	2. 0
646A	18	16	15	15	16	20	25	26	27	29	32	22	19	1. 1
WALLS														
Wallboard or Plaster-Lath on Wood Studs														
239	42	34	32	38	42	47	49	46	50	58	62	45	39	14. 2
240	30	22	31	30	37	39	44	43	39	45	52	37	31	7. 2
241	33	28	30	36	37	40	45	42	44	50	57	40	35	12. 9
242	36	31	36	40	40	46	47	50	52	41	45	42	38	6. 2
243	43	44	37	38	40	46	48	47	41	44	50	43	42	7. 7
244	41	41	41	43	46	48	49	45	41	49	54	45	44	13. 4



PANEL 245.

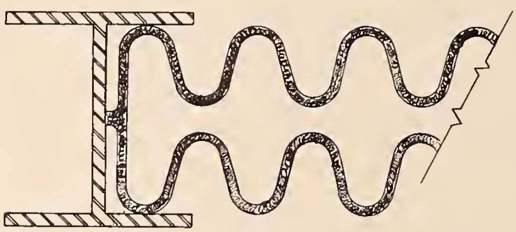
PANEL 245. *2- by 3-in. wood studs 16 in. on centers, staggered; ⅜-in. perforated gypsum lath, 16 by 48 in.; ½-in. sanded gypsum plaster.*



PANEL 440.

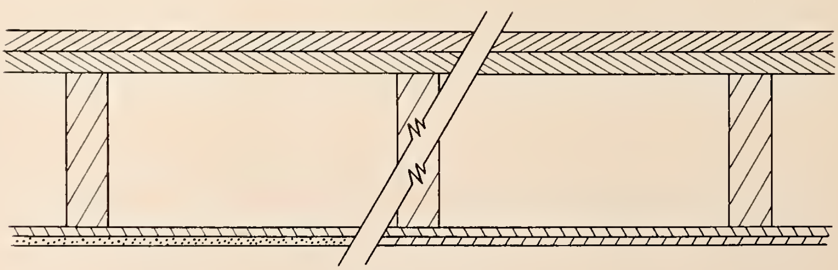
PANEL 440. *Five layers of ¾-in. cold-rolled steel channel, wire-tied together, formed core of panel. The center layer consisted of 2 pieces of channel 2-in. long placed vertically 40 in. apart and wire-tied between 2 horizontal lengths of channel. Vertical channels 16 in. on centers were wire-tied to the horizontal channels; ⅜-in. gypsum lath, 16-in. wide, was wire-tied to vertical channels; ½-in. sanded gypsum plaster.*

PANEL 441. *3½-in. steel trusses, 16 in. on centers; on each side spring clips 16 in. on centers fastened to trusses; ¼-in. metal rod wire-tied to clips; ¼-in. metal lath wire-tied to metal rods; ¾-in. sanded gypsum plaster. Same as panel 429 in BMS144, p. 50.*



PANEL 250.

PANEL 250. *23- by 23- by 1¾-in. hollow plastic panels, $\frac{3}{32}$-in. thick skin; set into 2 in. aluminum H beams; each face of each panel contained 800 horn-shaped depressions.*



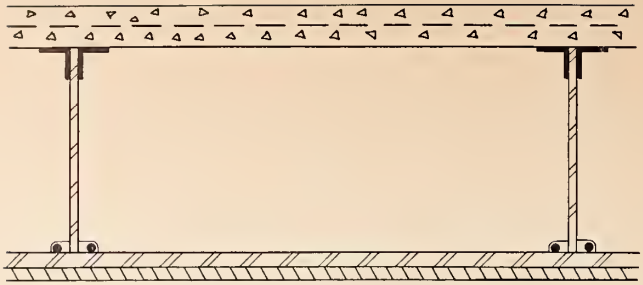
PANEL 714/713.

PANEL 713. *2- by 10-in. joists, 16 in. on centers; 1- by 6-in. subfloor, tongue and groove; $\frac{25}{32}$- by 4-in. finish floor, fir; ceiling side 2 layers of ⅜-in. gypsum wallboard; joints cemented and taped.*

PANEL 714. *Same as panel 713 except on ceiling side ⅜-in. perforated gypsum lath; ½-in. sanded gypsum plaster.*

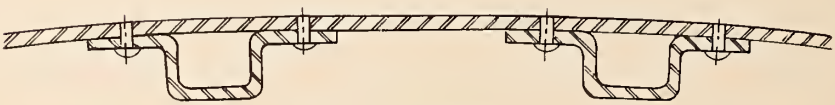
Table 3. *Sound Transmission Loss of Some Building Structures*—Continued

Panel number	Transmission loss (in decibels) at frequencies (cycles per second)													Weight lb/ft^2
	125	175	250	350	500	700	1,000	1,500	2,000	3,000	4,000	Decibel average 125 to 4,000	Energy average 125 to 4,000 [a]	
WALLS—Continued														
Wallboard or Plaster-Lath on Wood Studs—Continued														
245	48	48	46	47	48	47	48	43	48	55	59	49	47	15. 6
Gypsum Lath Wire-Tied to Steel Studs														
440	46	42	44	48	54	55	55	48	50	57	62	51	48	13. 5
Expanded-Metal Lath on Steel Studs														
441	49	48	49	51	53	56	59	53	58	63	63	55	52	18. 6
Miscellaneous														
250	20	18	16	19	24	26	32	36	32	28	29	25	22	1. 7
FLOORS														
Wood Joists														
713	28	27	28	34	32	36	44	48	52	51	55	40	32	12. 4
714	33	32	26	32	33	39	41	45	48	56	62	41	33	15. 6



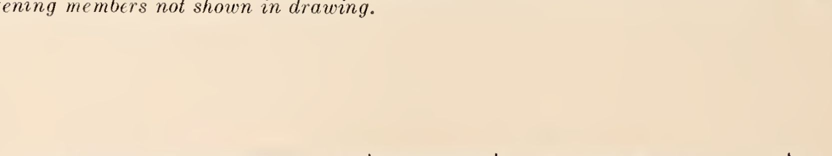
PANEL 806.

PANEL 806. *2-in. concrete on ⅜-in. rib lath; 6- by 6-in. wire mesh embedded in concrete; 12-in. open-web metal joists, 24-in. on centers; nailing channels wire-tied to lower side of joists; ⅝-in. wallboard; joints cemented and taped.*



PANEL 627.

PANEL 627. *Section of outer part of aircraft fuselage, aluminum alloy; outer skin 0.090 in. thick. The panel included some stiffening members not shown in drawing.*



PANEL 628.

PANEL 628. *Section of outer part of aircraft fuselage, aluminum alloy; outer skin 0.090-in. thick. The panel included some stiffening members not shown in drawing.*

PANEL 629.

PANEL 629. *Section of outer part of aircraft fuselage, aluminum alloy; outer skin 0.080-in. thick; inner layer 0.063-in. thick. The panel included some metal stiffening members not shown in drawing.*

Panel number	Transmission loss (in decibels) at frequencies (cycles per second)													Weight lb/ft [2]
	125	175	250	350	500	700	1,000	1,500	2,000	3,000	4,000	Decibel average 125 to 4,000	Energy average 125 to 4,000 [a]	
FLOORS—Continued														
Concrete Slab on Metal Studs														
806	40	38	40	43	46	48	51	54	53	51	54	47	44	34. 2
PART OF AIRCRAFT FUSELAGE														
627	22	16	14	18	24	23	23	------	23	------	23	21	[b] 20	2. 6
628	23	17	15	20	19	18	23	------	24	------	26	21	[b] 20	2. 6
629	23	17	13	20	25	22	24	------	29	------	27	22	[b] 20	2. 5

[b] Energy Average of sound transmission loss (STL) figures at 11 frequencies; STL figures at 1,500 and 3,000 cps were interpolated.

WASHINGTON, *April 15, 1958.*

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